Memphis Depot

Dunn Field
Groundwater Treatability Study

Presented by:
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Memphis Depot Restoration Advisory Board Meeting
October 21, 2004

U.S. Army Engineering and Support Center, Huntsville

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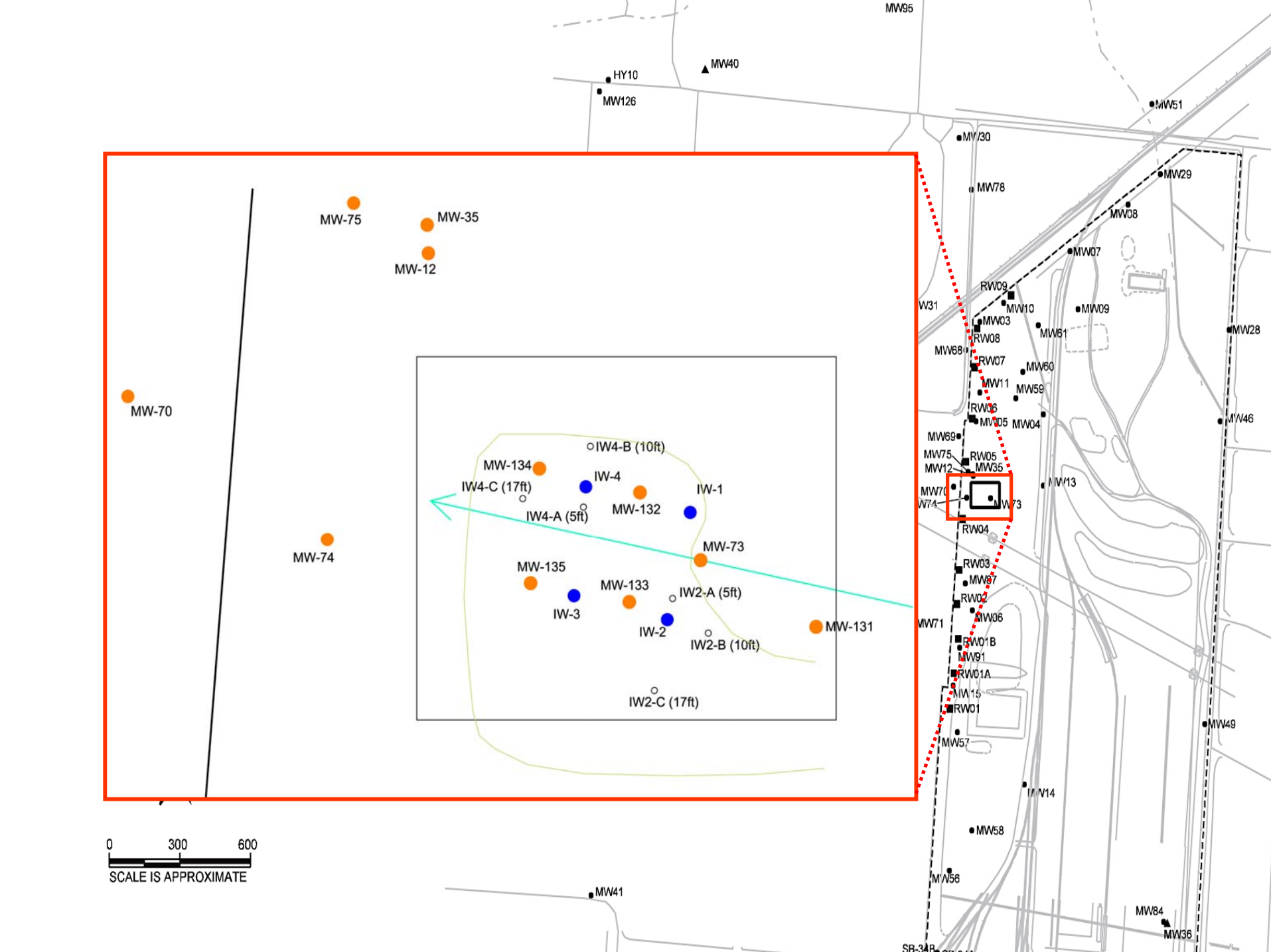
Background

- Dunn Field Record of Decision (ROD)
  - April 2004
  - Groundwater remedies:
    - Source Area: Zero-Valent Iron (ZVI) injection
    - Downgradient: Permeable Reactive Barrier (PRB) and Monitored Natural Attenuation (MNA)
- Treatability Study conducted to evaluate Source Area Remedy
  - Pilot test conducted at Dunn Field
  - October 29, 2003 to April 27, 2004

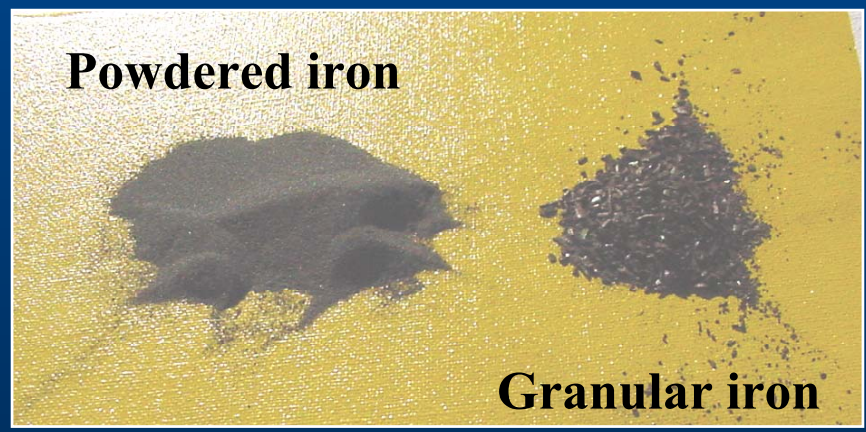

MW95
HY10
MW126
MW40
MW51
MW30
MW78
MW29
MW08
MW07
RW09
MW10
MW09
MW03
RW08
MW61
MW28
MW68
RW07
MW60
MW11
MW59
RW06
MW05
MW04
MW46
MW69
MW75
RW05
MW12
MW35
MW13
MW70
MW73
RW04
RW03
MW97
RW02
MW71
MW06
RW01B
MW91
RW01A
MW15
RW01
MW49
MW57
MW14
MW58
MW56
MW84
MW36
MW41
MW-75
MW-35
MW-12
MW-70
MW-74
IW4-B (10ft)
MW-134
IW4-C (17ft)
IW-4
IW-1
IW4-A (5ft)
MW-132
MW-73
MW-135
MW-133
IW2-A (5ft)
IW-3
IW-2
MW-131
IW2-B (10ft)
IW2-C (17ft)
0
300
600
SCALE IS APPROXIMATE

ZVI Technology

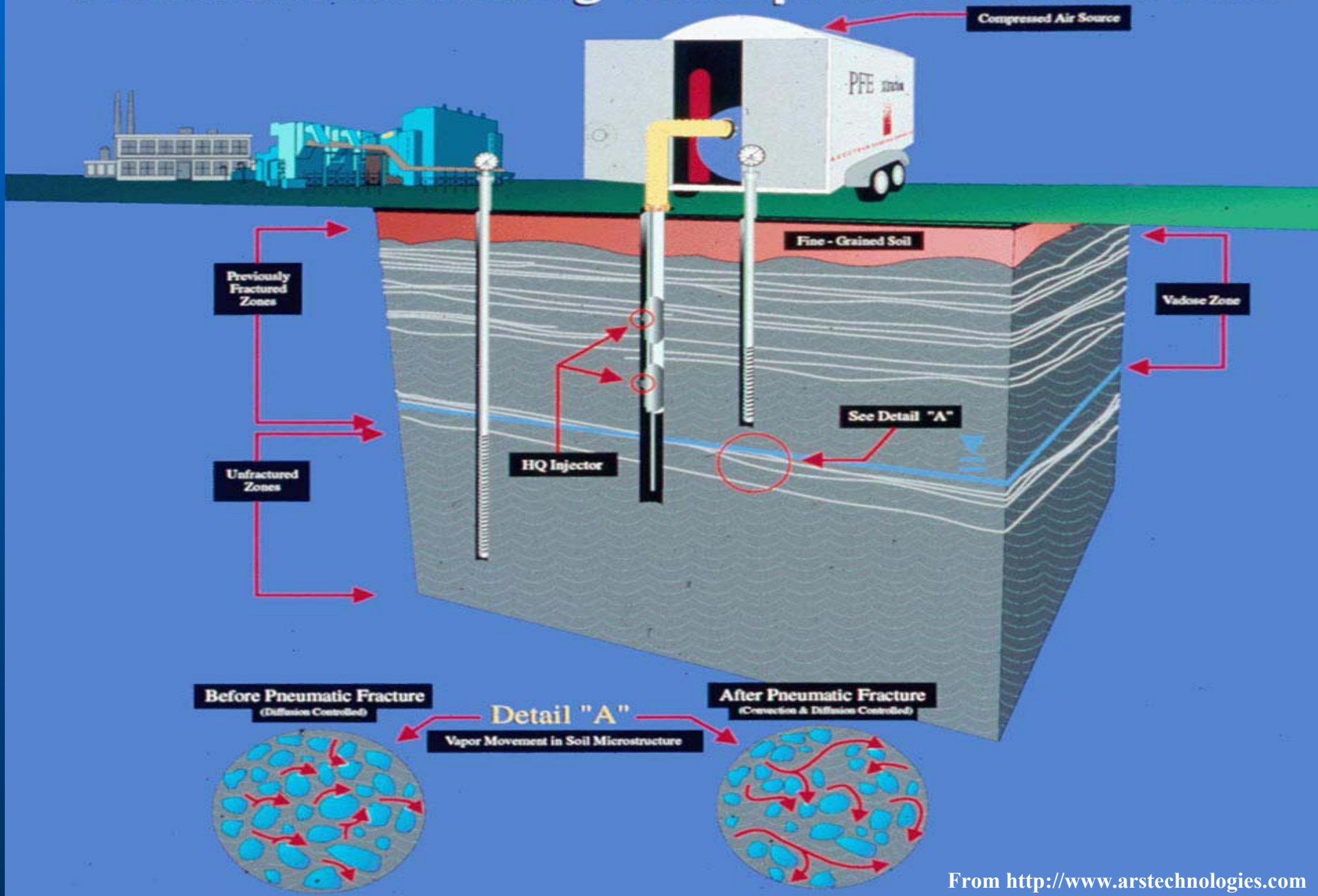
- ZVI has been used to treat groundwater affected by chlorinated solvents since early 1990s
- In the ground, ZVI slowly oxidizes and produces hydrogen and ferrous iron
  - Chemical reaction occurs that reduces the concentrations of Chlorinated Volatile Organic Compounds (CVOC)

ZVI Technology

- ARS Technologies, Inc. (ARS)
  - Leading environmental contractor in ZVI injection and pneumatic fracturing technology
  - Drilled injection boreholes and injected ZVI using compressed nitrogen during pilot tests
  - Batch mixing



Pneumatic Fracturing Concept Fine-Grained Soils



From http://www.arstechnologies.com

Treatability Study Objectives

- Determine effectiveness of ZVI to treat CVOCs in groundwater
- Determine amount of ZVI needed to treat CVOCs source areas effectively
- Define approximate radius of influence (ROI) of ZVI injection (treatment area)
- Assess most effective drilling and injection methods to achieve best results
  - Spacing and orientation of injection boreholes
  - Injection pressures
  - Injection duration

Treatability Study Area

- Target areas with highest concentration of CVOCs in shallow aquifer
  - 75 to 90 feet below ground surface (bgs)
- Seven monitoring wells (5 new)
- Four injection boreholes (IW-1 to IW-4)

Site Preparation

- Work area stability
  - gravel and a geomembrane layer
- Mobilization
  - Rotasonic drilling rig
  - ZVI batch mixing trailer
  - Compressed nitrogen tubes trailer
- Site safety area
- Hydrogeologic testing

ZVI Injection Process

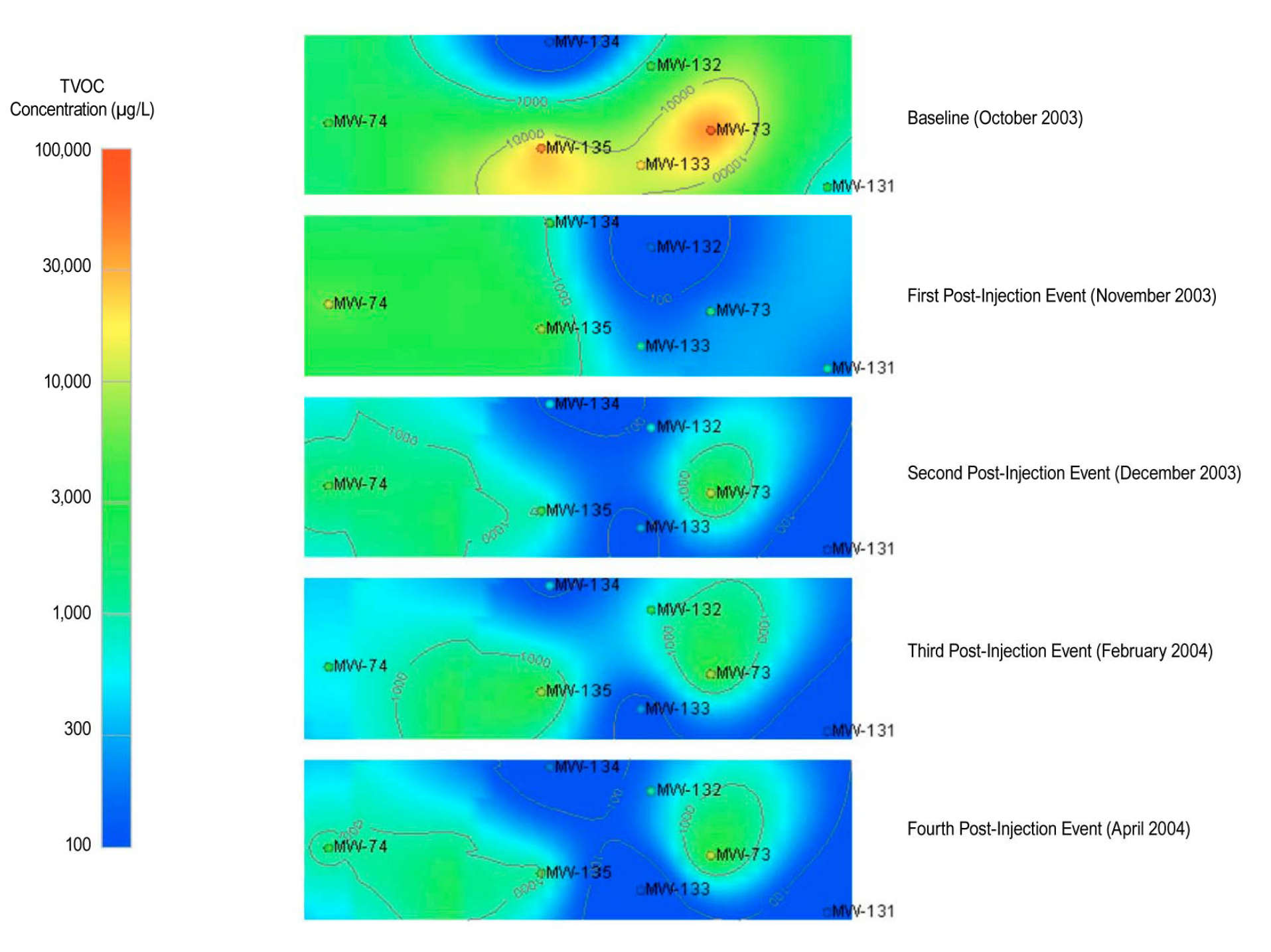
- Compressed nitrogen injection
  - Creates fractures in the soil that act as pathways for the ZVI
- ZVI/water slurry injection
- Clean water and nitrogen injection to flush system
- 2 to 2.5-foot intervals within the saturated zone

Injection Summary

- Total ZVI injected: 24,925 pounds
  - IW-1 6,599 pounds
  - IW-2 8,199 pounds
  - IW-3 2,882 pounds
  - IW-4 7,245 pounds
- Field observations
  - ZVI was distributed throughout the anticipated area of influence
  - Particularly concentrated along soil fractures

Groundwater Monitoring

- Baseline (pre-injection) sampling event
  - October 22 to 23, 2003
- Four post-injection sampling events
  - November 17 to 19, 2003
  - December 17 to 19, 2003
  - February 2 to 3, 2004
  - April 5 to 7, 2004
- Assess CVOC reduction rates


TVOC
Concentration (µg/L)
100,000
30,000
10,000
3,000
1,000
300
100
MW-134
MW-132
MW-74
MW-73
MW-135
MW-133
MW-131
Baseline (October 2003)
First Post-Injection Event (November 2003)
Second Post-Injection Event (December 2003)
Third Post-Injection Event (February 2004)
Fourth Post-Injection Event (April 2004)

Results

- Average 95% decrease in CVOC concentrations in study areas
- No accumulation of undesirable byproducts
  - Vinyl chloride
  - Dichloroethene (DCE)
- Minimal hydrogeological impact
- Radius of injected ZVI ~ 25 feet (based upon confirmatory soil samples)
- Zone of influence ~ 40 feet
- 700 to 800 tons of ZVI required for full-scale remedy

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